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Economic Transformation and Human Development Index in Nigeria: An Econometric Evaluation of the Endogenous Growth Model

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Abstract: This research seeks to examine the impact of human development index (HDI) on economic transformation Nigeria. The paper adopted error correction mechanism to accentuate the dynamic paths of variables and aptitude of these variables to return to long-run equilibrium after a shock. From empirical results, it was found that HDI and school enrolment were most statistically significant in Nigerian growth equation. We thus recommend as a policy that emphasis human capital development in Nigeria most especially when the Nigerian nation is labor-intensive one.

Keywords: Human Development Index, Economic Transformation, Endogenous Growth Model, Nigeria

1. Introduction

Human capital seems to assume a critical dimension in economic literature. This was the period when most nations were eager to overcome economic problems. For example, Mankiw (1995) recounts the “miracle” story of rapid growth in Japan and Germany between 1948 and 1972. According to him, output per man grew by 8.2% in a year in Japan while it was 5.7% in a year in Germany. This development was informed by human capital asset via the instrument of technology.

The dual components of this capital are education and healthy living. According to Isola and Alani (2012), healthy living is germane to development. No wonder, the advent of the administration of the late President Umaru Musa Yar’Adua having a Seven Point Agenda hinged on education along with health was a step in the right direction confirming need for human development in the country.

2. Literature Review of the Endogenous Growth Model (EGM)

Endogenous model is the latest option to the theory of growth. This embraces diverse parts of studies that evolved in the 1980s. The model by Romer (1986) and Lucas (1988) relates growth of an economy to variables such as the savings rate and the spending on education. The model explains long-term growth as function of technological knowledge.

Endogenous growth theory challenges the neoclassical view by proposing channels of transmission through which long run growth can be influenced by technological progress. This is also caused by innovations emanating from R and D expenditures undertaken by profit-seeking firms, economic policies with respect to trade, competition, education, taxes and intellectual property (Howitt, 2000).

Technological progress is endogenized via “learning by doing or innovation process”. It introduced human capital into the model with prediction that savings rate affects growth rate. It also predicted that capital accumulation could sustain long term growth while economic policy could accelerate or decelerate growth. Generally, the endogenous growth model stressed significance of innovation, human capital, governance and institutions in the overall growth objectives (Romer, 1986). In other words, it is not only factor accumulation that drives growth but also efforts to utilize them (Rebelo, 1999).

The new endogenous model maintains that diminishing returns-to-scale phenomenon may be untrue as seen in East Asian economies. Differently put, what this means is that if the firm which invests in capital also employs educated and skilled labour force who are also healthy, then labour productivity and efficiency would thrive. This will lead to the so called *Hicks Neutral*, shift in production function and thus there can be increasing rather than decreasing returns to investments.

However, to establish the point whether effective or quality labour was one of factors in explaining growth for these Asian countries, Lucas, (1988) examined how total literacy rate and life expectancy through a cross sectional study of countries in East Asia contributed to growth. He discovered positive relationship between human capital and growth in these regions.

3. Empirical Model

The model being considered takes its root from neoclassical growth model. The model accentuates the fact that growth results from physical capital denoted *(Z)* and labour force *(M)*. The Neoclassical and Solovian production function exhibits constant returns to scale in labour and capital as follows:

$$Q_{(t)} = Z_{(t)}^{\zeta} O_{(t)} M_{(t)}^{1-\zeta}, \quad 0 < \alpha < 1 \tag{3.1}$$

Where Q_t is output at time (t), Z_t is capital at time (t), O_t is technology at time (t) (effectiveness of labour), *O and M* grows exogenously at rates of n and g. The growth of labour force *(M)* is define as n, while the efficiency of labour (O) grows at g, therefore we can defined labour force in time, t $(M_{(t)}$ and technology at time, t $(O_{(t)}$ to be:

$$M_{(t)} = M_{(0)} e^{nt} \tag{3.2}$$

$$O_{(t)} = O_{(0)} e^{gt} \tag{3.3}$$

The Solow’s model assumes that savings rates, *(s)* population growth *(n)*, technological progress *(O)* are all exogenously determined while capital and labour are remunerated with marginal products. Effective labour $O_{(t)}\ M_{(t)}$, grows at $n+g$ with fraction of output, s, is invested. In intensive form, we have $z = Z/OM$, and y as the level of output per effective unit of labour, $q = Q/OM$, therefore n is governed by

$$z_{(t)} = sq_{(t)} - (n+g+\delta)z_{(t)}$$
$$\Rightarrow sz_{(t)}\zeta - (n+g+\delta)z_{(t)} \tag{3.4}$$

Where; δ is depreciation rate, the implication of equation (3.4) is that z settles at steady state z^*. Much recent theoretical work on growth was motivated by informal examinations of the relationships between savings (s) population growth (n) and income (q).

Since the Solow model do not provide for differentials in income among different countries, endogenous model incorporated knowledge as part of the aggregate capital (z) such that technological knowledge is labour-augmented, thereby acting as a pivot to labour productivity. Thus,

$$Q = Z^{\zeta}(OM)^{1-\zeta} \tag{3.5}$$

Where *OM* is knowledge adjusted workforce with research workers create technological knowledge. In a simple form, this is expressed as:

$$\frac{dO}{dt} = \delta H_o O \tag{3.6}$$

Where H_O is human capital of research workers, δ is parameter. Romer (1990) therefore inferred that the more researchers, the additional ideas are created, and the longer the existing knowledge O, the more new ideas produced. Equation (3.6) shows that technical progress is human capital determined.

Mankiw, Romer and Weil (1992) developed augmented Solow equation which this work is predicated on. Thus:

$$Q_{(t)} = Z_{(t)}\zeta H_{(t)}\xi O_{(t)} M_{(t)}{}^{1-\zeta-\xi} \tag{3.7}$$

Where ζ is physical capital share of income, ξ is human capital share of income, *H* is volume of human capital. If *sz* is fraction of income invested in physical capital and *sh* is the proportion spent in human capital, the given economy is determined by:

$$z_{(t)} = szq_{(t)} - (n+g+\delta)\, z_{(t)} \tag{3.8}$$
$$\dot{h}_{(t)} = shy_{(t)} - (n+g+\delta)h_{(t)} \tag{3.9}$$

Where; $q = Q/OM$ (ratio of per capital income to labour), $z = Z/OM$ (physical capital labour ratio), $h = H/OL$ (human capital labour ratio).

$$K^*(S_k{}^{1-\xi} S^{\xi} h)1/1-\zeta-\xi \tag{3.10}$$

From equation (3.10), we have that $1-\zeta-\xi = 0, 1 = \zeta+\xi$ (constant returns in reproducible factors), $\zeta+\xi<1$ (decreasing returns in reproducible factors), $1<\zeta+\xi$ (increasing returns in reproducible factors). This shows absence of steady state in the model. Equation (3.8) and (3.9) indicates economy converges to a steady state defined as:

$$M^* = \left(\frac{S_z{}^{1-\xi} S^{\xi} h}{n+g+\delta}\right)1/1-\zeta-\xi \tag{3.10a}$$

$$h^* = \left(\frac{S_z{}^{\zeta} S_h{}^{1-\zeta}}{n+g+\delta}\right)1/1-\zeta-\xi \tag{3.10b}$$

Substituting (3.10a) and (3.10b) into equation 3.7 and taking logs gives:

$$\ln\left(\frac{Q_{(t)}}{M_{(t)}}\right) = \ln O(0) + g(t) - \frac{\zeta+\xi}{1-\zeta-\xi}\ln(n+g+\delta) + \frac{\zeta}{1-\zeta-\xi}\ln(sz) + \frac{\xi}{1-\zeta-\xi}\ln(sh) \quad (3.11)$$

Augmented Solow equation is also predicated on α, which is the physical capital's share of income and ξ, which is the human capital's share of income. In sum,

$$Q = OZ^{\zeta}(hM)^{\xi} \quad (3.12)$$

We pursue a modified version of growth framework in specifying a growth-human capital model.

Drawing from the theoretical foundation earlier outlined, we let aggregate output produced in the economy in time *t*, Q_t, to follow a linear fraction of total capital stock (K_t) and labour resources M_t to be:

$$Q_t = M_t{}^{\zeta}\zeta H_t{}^{\xi}(T_t L_t)^{1-\zeta-\xi} \quad (3.13)$$

Given that output may either be consumed or transformed into z-type or H-type capital, we have:

$$Y_t = C_t + z_t + \delta_k Z_t + \dot{H}_t + \delta_H H_t \quad (3.14)$$

Where C_t is consumption and the overdot indicates a time derivative k-type and h-type capital depreciate at rates δ_k and δ_H respectively. It is further assume further that output Q_t depends on inputs of raw labour L_t and three types of accumulated factors: Z_t, H_t *and* T_t. The factors Z_t (capital stock) and H_t (human capital) are accumulated through sacrifice of output. The factor T_t, which could be an index of technology acquired through *learning-by-doing,* accumulated as a by-product of economic activity does not require sacrifice of output.

Based on the foregoing theoretical underpinning enshrined, our functional model is specified as follows:

$$grr_t = f(hdi_t, lrr_t, gcf_t, pgr_t, gex_t, ler_t, sse_t) \quad (3.15)$$

Where; *grr* is economic growth rate, *hdi* is human development index, *lrr* is literary rate, *gcf* is gross capital formation, *pgr* is population growth rate, *gex* is government expenditure, *ler* is life expectancy rate, *sse* is secondary school enrolment and U_t is stochastic term (expected to be Gaussian-white noise). In a more econometric manner, equation (3.15) is restated as:

$$grr_t = \psi_0 + \psi_1 hdi_t + \psi_2 lrr + \psi_3 gcf_t + \psi_4 pgr + \psi_5 gex_t + \psi_6 ler + \psi_7 sse_t \quad (3.16)$$

Thus, error correction specification is:

$$\nabla Z_t = \Gamma_1 \nabla Z_{t-1} + \Gamma_2 \nabla Z_{t-2} + \ldots + \Gamma_{k-1}\nabla Z_{t-k-1} + \Pi Z_{t-1} + \eta_t \quad (3.17)$$

Where; $\Gamma_1 = -(1 - A1 - ... - Ai)(i = 1...K - 1)$, a matrix representing short-term adjustments and $\Pi = -(1 - A1 - ... - AK)$, being a coefficient matrix showing long-run relationship between the vector, Z_t is px1 vector of stochastic variables integrated of order one, K is lag order and η_t is (p by1) white noise residual factor. Therefore, from equation (3.17), we have,

$$\partial \ln grr_t = \psi_o + \psi_1 \ln hdi_t + --- + \psi_n \partial sse_t + \psi_k ecm_t \tag{3.18}$$

All the explanatory variables are expected to have a positive relationship with *GRR*. The paper employs regression technique, it relied extensively on error correction mechanism to establish the long and short run correlation between output growth with associated indicators and variables of human development in Nigeria from 1980-2016.

4. Discussion of Empirical Results

4.1 Results of Unit root Test

The results of the Philips-Perron test did not reject the null hypothesis about the existence of unit roots at the level form of the data set, hence resulting in the differencing of the series. Results of first differenced form of series in table 4.1 below, however, rejected the null hypothesis; implying series became stationery after their first difference. Therefore, all the variables order one.

Table 4.1: Analysis of the Stationarity Test

Philips-Perron (PP) Test			
Variable	Test Statistic	Critical Value	Order of Integration
grr	-7.36092	-3.20891	1(1)
hdi	-9.62104	-3.20891	1(1)
lrr	-6.99412	-3.20891	1(1)
gcf	-7.44280	-3.20891	1(1)
pgr	-17.8741	-3.20891	1(1)
gex	-9.14265	-3.20891	1(1)
ler	-5.42022	-3.20891	1(1)
sse	-4.96601	-3.20891	1(1)

The lag lengths were automatically selected by E-views and test equations, included intercept.

Stability Test

The autoregressive (AR) stability test for unit root was conducted to ascertain the consistency or otherwise of the coefficients of the normalized co integrating model. The test results in table 4.2 below. Since all the roots had modules below one, it means that none of the roots fell outside unit circle.

Table 4.2: Auto Regressive (AR) Root Stability Test

Root	Modulus
0.886412	0.887523
0.921654-0.051273¡	0.824614
0.895533 + 0.071242¡	0.827734
0.920221 – 0.155721¡	0.6324721
0.605114+ 0.16423¡	0.5549735
0.340256	0.346743
- 0.011074	0.000195

Johansen's Test for Co integration Vectors

Johansen co-integration test applied the maximum lag order 1 along with constant trend specification. Co-integration test results are in table 4.3 as revealed by the standard trace and Eigenvalue test statistics shows the presence of 1 co-integrating vector among the variables.

Table 4.3: Johansen's Co integration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statiastic	0.05 Critical value	Prob**
None*	0.695899	45.21143	4.16125	0.0000
*denotes rejection of the hypothesis at 5% level ** Mackinnon-Haug-Michelis (1999) p-values Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical value	Prob**
None*	0.695899	45.21143	4.16125	0.0000
*denotes rejection of the hypothesis at 5% level **Mackinnin-Haug-Michelis (1999) P-values Unrestricted co-integrating coefficients (normalised by b' *S11*b=1):				

Long-run Static Relationship

From the result below, the a *priori* expectation for all the variables was met except for literacy rate and life expectancy rate. The test therefore shows good performance. Long run regression results indicate that overall impact of the variables on economic transformation in Nigeria. From R-squared, it shows that over 60 percent of the systematic variation in GRR is explained and captured by the variations in the group of explanatory variables. This is given more credence by R-Bar squared.

Table 4.4: Long run Static Relationship

Variables	(1980-2016)
C	5.246 (2.941)** t-value
hdi	0.149 (4.162)* t-value
lrr	-0.124 (1.451) t-value
gcf	0.042 (5.121)* t-value
pgr	1.212 (3.514)* t-value
gex	0.246 (1.251) t-value
ler	-0.112 (1.211) t-value
sse	0.165 (2.742)** t-value
R-squared	0.607
Adjusted R-squared	0.5826
DW statistics	2.100
F-statistic	170.3712*
T-statistic values are reported in parenthesis below each coefficient *, **, *** indicates significance at 1%, 5%, 10% level	

The DW statistics has a coefficient of 2.1002, indicating absence of autocorrelation. This implies that the BLUE properties of the least square estimates are restrained. Therefore, the estimates obtained are consistent and reliable. The F-statistic is significant. The result revealed that variables in the model are significant at 1 percent level. This indicates that the group of explanatory variable is a significant determinant of the dependent variable.

From the coefficients of the result above, it shows that 10 percent rise in HDI increases rate of economic transformation by 1.4 percent. Also, boost in population growth along with school enrolment translates into economic transformation by 12.14 and 1.6 percent respectively. There is however a negative association amid economic growth with literacy rate as well as life expectancy rate.

Short-run Dynamic Relationship

Traditionally, the over-parameterized model was condensed to achieve a parsimonious model in table 4.5 above. The parsimony maximized statistical robustness of the model with a minimum quantity of explanatory variables. Method of reduction was duly conditional by statistical considerations, economic theory and interpretability of the estimates. Therefore, the parsimonious reductions procedure employs the stepwise regression procedure.

Table 4.5: The short-run Dynamic Relationship

Variables/Constants	Regression Results (1980-2016)
C	-0.121 (-0.312) t-value
Dgrr(-1)	0.375 (2.831)* t-value
Dhdi(-1)	0.452) (2.623)* t-value
Dlrr(-1)	-0.091 (1.826)*** t-value
Dgcf	0.297 (3.216)* t-value
Dgex	0.474 (2.241)* t-value
Dpgr(-1)	1.426 (4.322)* t-value
Dler (-1)	-0.125 (-1.674)*** t-value
Dsse (-1)	0.236 (2.842)* t-value
ecm (-1)	0.207 (2.412)* t-value
R-squared	0.692
Adjusted Re-squared	0.6524
D-W statistics	1.935
F-Statistics	17.724
*, **, *** indicates significance at 1%, 5%, 10% level	

From short run dynamic relationships or the parsimonious model, it was discovered that all estimated parameters perform better in the parsimonious model when compared with over-parameterized model. The ecm coefficient was found significant with the right sign, indicating that long-term equilibrium was attainable as the shocks generated by exogenous factors could be corrected to restore equilibrium. Judging from the overall fit, the parsimonious model had better fit compared with the over-parameterized model, with a higher value for the adjusted R-squared (0.65 compared with 0.58 respectively).

5. Conclusion

This paper examined the impact of human development index on economic transformation in Nigeria via error correction model. Results of parsimonious model indicate that HDI and secondary school enrolment had significant impact on economic progression in Nigeria.

On this basis, effort should be made at policies aimed at developing human capital in Nigeria most especially when Nigerian nation is a labour-intensive one. So, productivity in the economy should be labour-skewed and labour-driven, when this is done, the quest of becoming the 20th largest economy by the year 2020 will almost be attain, if not fully attained. This was productivity template adopted in China and most of the South East Asian (SEA) countries that galvanized and pivoted their economies around their increasingly growing population, and today, they have compete with the traditionally acclaimed industrial nations.

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